

CHAPTER 3 INSTALLATION REQUIREMENTS

SECTION 301 GENERAL

301.1 Scope. The provisions of this chapter shall govern the installation of photovoltaic (PV) components including location, materials and structural support. Where the installation of PV systems is not covered by this code the installation shall be in compliance with the Oregon Structural Specialty Code.

SECTION 302 DEFINITIONS

(ICC proposal IBCS 22-09/10)

(1502.1) 302.1 General. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

CONVENTIONAL LIGHT-FRAME WOOD CONSTRUCTION. A type of construction whose primary structural elements are formed by a system of repetitive wood-framing members. See OSSC Section 2308 for conventional light-frame wood construction provisions *or the prescriptive framing provisions of the Oregon Residential Specialty Code.*

PHOTOVOLTAIC MODULES/SHINGLES. A roof covering composed of flat-plate photovoltaic modules fabricated in sheets that resemble three-tab composite shingles.

RACKING. A system of structure that directly supports the PV panels and transfers the applied loads to the building structure or ground-supported structure. *(This is a first stab at a def. and may need additional work.)*

SECTION 303 MINIMUM STANDARDS AND QUALITY

303.1 General. Photovoltaic (PV) components, racking, support structures and attachments shall be in accordance with the provisions of this chapter. PV systems shall be designed and installed in accordance with this code and the approved manufacturer's instructions. Where the installation of PV systems does not comply with the provisions of this section the installation shall comply with the OSSC.. *(sim to OSSC 1503 Roof coverings)*

(1509.6) **303.2 Roof mounted photovoltaic panels and modules.** Photovoltaic panels and modules mounted on top of a roof shall be listed and labeled in accordance with UL 1703 and shall be installed in accordance with the manufacture's installation instructions. *(Add from S13- 09/10)* Rooftop installed photovoltaic systems that are adhered or attached to the roof covering shall be labeled to identify their fire classification in accordance with the testing required in Section 1505.1

For reference: (ICC proposal IBC S13-09/10) added portion to 303.2

303.1.x Photovoltaic systems. Rooftop installed photovoltaic systems that are adhered or attached to the roof covering shall be labeled to identify their fire classification in accordance with the testing required in Section 1505.1

(1507.17) **303.2.1 Photovoltaic modules/shingles.** The installation of photovoltaic modules/shingles shall comply with the provisions of this section.

(1507.17.3) **303.2.1.1 Wind resistance.** Photovoltaic modules/shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Photovoltaic modules/shingles shall comply with the classification requirements of Table 1507.2.7(2) for the appropriate maximum basic wind speed. Photovoltaic modules/shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table 1507.2.7.1(2). (S28-09/10 1509.6.1) Rooftop mounted PV systems shall be designed for wind loads for component and cladding in accordance with OSSC Chapter 16 using an effective wind area based on the dimensions of a single unit frame.

303.3 Ground supported rack-mounted photovoltaic panels and modules. (*Not sure this will be needed.*)

(1507.17.1) **303.4 Material standards.** Photovoltaic modules/shingles shall be listed and labeled in accordance with UL1703.

SECTION 304 LOCATION.

304.1 General. The location of Photovoltaic (PV) components, racking, support structures and attachments shall be in accordance with the provisions of this chapter.

304.2 Zoning requirements. The installation of PV systems shall comply with the requirements of the zoning requirements of the Authority Having Jurisdiction (AHJ).

304.3 Flood Hazard Areas. Installation of PV systems within flood hazard areas, as defined by the AHJ, shall comply with the following;

304.3.1 Protection of mechanical and electrical systems. Electrical systems, equipment and components shall be located above the design flood elevation. If replaced as part of a substantial improvement, electrical systems, equipment and components shall meet the requirements of this section. Systems, fixtures, and equipment and components shall not be mounted on a penetrate through walls intended to break away under flood loads.

Exception: Electrical systems, equipment and components are permitted to be located below the design flood elevation provided that t designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistant construction requirements of the OSSC. Electrical wiring systems are permitted to be located below the design flood elevation provided they conform to the provisions of the Oregon Electrical Specialty Code for wet locations.

Refer to zoning, solar access, flood hazard areas, height, etc. Also, the flood hazard area requirements should probably just be references to like to the ORSC section R324.1.5 and/or OESC sections. For example;

For reference from the ORSC

R324.1.5 Protection of mechanical and electrical systems. Electrical systems, equipment and components, and heating, ventilating, air conditioning and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall be located above the design flood elevation. If replaced as part of a substantial improvement, electrical systems, equipment and components, and heating, ventilating, air conditioning, and plumbing appliances, plumbing fixtures, duct systems, and other service equipment shall meet the requirements of this section. Systems, fixtures, and

equipment and components shall not be mounted on or penetrate through walls intended to break away under flood loads.

Exception: Electrical systems, equipment and components, and heating, ventilating, air conditioning and plumbing appliances, plumbing fixtures, duct systems, and other service equipment are permitted to be located below the design flood elevation provided that they are designed and installed to prevent water from entering or accumulating within the components and to resist hydrostatic and hydrodynamic loads and stresses, including the effects of buoyancy, during the occurrence of flooding to the design flood elevation in compliance with the flood-resistant construction requirements of the *Building Code*. Electrical wiring systems are permitted to be located below the design flood elevation provided they conform to the provisions of the *Electrical Code* for wet locations.

SECTION 305 STRUCTURAL

305.1 General. Photovoltaic (PV) components, racking, support structures and attachments shall be in accordance with the provisions of this chapter.

305.2 Racking. *(should probably do a def for "racking")* Racking shall comply with this section.....

305.2.1 Weather protection ?. *(From BCD draft)* Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration.

305.2.2 Structural Support. Racking and racking supports shall be mounted to structural components and shall not be attached to wall or roof coverings, trim or structural sheathing as a means of structural support members in accordance with section xxx. *(Not sure I like the wording yet).*

305.2.3 Connection to structural members. Racking and racking supports shall be attached to the structural components through the use of screws, bolts, j-bolts, or other approved means in accordance with manufacturer's specifications or be designed in accordance with accepted engineering practice.

(BCD Draft language) Racking Installations; General: Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration. Racking and racking supports shall be mounted to structural components and will be attached to the structural components through the use of screws, bolts, j-bolts, or other approved means in accordance with manufacturer's or engineer's instructions. Screws smaller than No. 10 or bolts smaller than 1/4" shall not be allowed, in addition, the use of plywood, particle board or chipboard as the sole supporting means for racking shall not be allowed.

305.2.3.1 Roof mounted arrays

305.2.3.1.1 Attachment. Photovoltaic modules/shingles shall be attached in accordance with the manufacturer's installation instructions *or shall be designed in accordance the OSSC.*

305.2.3.2 Ground mounted arrays

305.2.3.2.1 (1507.17.2) Attachment. Photovoltaic modules/shingles shall be attached in accordance with the manufacturer's installation instructions *or shall be designed in accordance the OSSC.*

(The blue portion are portions of the SOC-ICC provision)

305.3 Roof installation on conventional light-frame construction. Installations that comply with this section shall qualify as a prescriptive installations if all of the following criteria are met:

305.3.1 Roof structure: The supporting roof framing shall be *conventional light framed wood construction* with a maximum spacing of 24 inches [mm] on center and installed in accordance with Figure xxxx

305.3.2 Roof materials. Roofing material shall be standing seam metal, single layer wood shingle or shake, or not more than two layers of composition shingle.

305.3.3 Loading: Collectors are either directly attached to the roof framing or are mounted to continuous rails that are attached directly to the roof framing. These attachments must be anchored to roof framing at a spacing no greater than 4 ft. on center maximum or per manufacturer's instructions. Collector and mounting hardware (rails, frame, etc) weight shall not exceed 4.5 pounds per square foot (psf). Solar thermal collector weight shall include the weight of the working fluid inside the collector. See attached diagram #1A.

305.3.4 Height: Maximum panel height above roof shall be 18" from top of panel to roof surface and in accordance with Figure xxxxx

(Move this stuff to chapter 1 ??)

Permit Submittal Requirements

The following information shall be submitted for each permit application for a PV installation.

1. Structural Plans

a. Prescriptive system. If the system meets all of the prescriptive requirements of the structural section of this program guide, no structural plans and calculations will be required. Data showing that the solar installation meets the prescriptive requirements must be included with the site plan.

b. Designed elements.

If any of the prescriptive requirements for roof structure, roof materials, loading or height are not met, then structural calculations by an Oregon engineer showing complete details for the rails, support struts and roof attachments must be provided. In addition, stamped calculations verifying adequacy of the roof construction are required.

In the case where the support struts raise the panel height greater than 18" above the roof but all other prescriptive requirements of this program guide are met, then structural calculations by an Oregon engineer and details only for the support struts and its connections are required. In some cases, manufacturer's information and installation details may be substituted for the required engineering.

2. Elevation Drawings

For installations where the panels will not be mounted flush with the roof, a simple building elevation will be required to measure the height of the installation. The elevation must show the height of the building, and the height of the solar installation, but does not need to show other building details, unless a Design Review will be required.

(Add standard)

UL

1703-02 Flat-Plate Photovoltaic Modules and Panels – with revisions through April 2008

(BCD draft)

Racking Installations; General: Frames, braces and attaching devices exposed to the weather shall be constructed of materials approved for exterior locations and protected from corrosion or deterioration. Racking and racking supports shall be mounted to structural components and will be attached to the structural components through the use of screws, bolts, j-bolts, or other approved means in accordance with manufacturer's or engineer's instructions. Screws smaller than No. 10 or bolts smaller than ¼" shall not be allowed, in addition, the use of plywood, particle board or chipboard as the sole supporting means for racking shall not be allowed.

Arrays: Roof Mounted Array panels shall be anchored to roof structural components in a manner to resist wind, snow, vibration or seismic loading in compliance with the applicable Oregon Building Codes. Anchors secured to and through roofing material shall be made in a manner to maintain the water integrity of the roof covering. Roof drainage shall not be impaired by the installation of panels or racking. Panels which are not an integral part of the roofing system shall be installed in a manner so as to preserve the integrity of the roof surface; inspection of the attachment method shall occur prior to setting of panels.

Arrays: Pole or other structure mounted systems: Arrays mounted to pole or structures other than a roof shall be anchored in a manner to resist wind, snow, vibration, or seismic loading. Engineered drawings detailing soil conditions, depth of concrete base, concrete base rebar makeup may be required to approval of permit. Any pole mounted solar installation shall have the concrete or supporting base no less in depth than the frost line as required in the Oregon Structural Specialty Code. Alternate attachment and support methods may be approved by the authority having jurisdiction.

Arrays: Ground Mounted

In addition to being anchored in a manner to resist wind, snow, vibration, or seismic loading, panels installed at ground level shall be at least six (6) inches (152 mm) above the ground level.

Equipment Location: Components shall not be so located as to interfere with the normal operation and use of windows, doors, or other required facilities or obstruct access to equipment such as: inverters, batteries, electrical disconnects, meters, valves. Array Panels constructed of combustible materials shall not be located on or adjacent to construction required to be of non-combustible materials or in special fire areas unless approved by the Authority Having Jurisdiction.

Controls: Required electrical, mechanical, safety, and operating controls shall be of such design and construction as to be suitable for installation in the environment in which they are located.

Protection: Any portion of the solar system installed where it may be subjected to mechanical damage shall be guarded against such damage by being installed behind barriers such as bollards, fences, or other approve means or when located within a garage be elevated a minimum of 48" above finished garage floor or located out of the normal path of a vehicle.

Fire Safety Requirements/Fire Fighter Access:

Solar arrays which function as building components shall comply with the Building Code, and shall not reduce the required fire-resistance or fire classification of the structure. Examples include but are not limited to: curtain walls, membrane roofing, sky lights and solar windows. On residential structures, solar arrays shall maintain a minimum clearance of 36" from all edges, peaks, valleys, roof access points, skylights. In addition, a minimum 36" wide pathway shall be maintained to access skylights, roof hatches, HVAC equipment or other equipment requiring maintenance. On commercial structures a 48" wide pathway shall be maintained from all edges, peaks, valleys, roof access points, skylights. In addition, a minimum 48" wide pathway shall be maintained to access skylights, roof hatches, HVAC equipment or other equipment requiring maintenance, this pathway shall be directly over roof structural members. (See attached examples for best design practices).

Installation of conductors, conduits, combiner boxes, disconnects shall be made in such a manner as to not create a tripping hazard or impede fire-fighter access nor cross through the required pathway.

Each solar array string shall be installed with a visible D/C disconnect. This disconnect shall be marked "Array # __ D/C disconnect". Letters shall be a minimum of 1" in height, suitable for the environment and red in color.

This space reserved for examples of "best practice" installations relating to fire fighter access.

Identification of Solar Photovoltaic System Components in Common System Configurations.

(From SOC-ICC)

Structural

The following provisions apply when the solar collectors and underlying substructure (mounts, rails, etc.) are designed to meet the loading requirements of the Oregon Residential Specialty Code or the Oregon Structural Specialty Code. The prescriptive requirements as described in this section are assumed to meet the residential code requirements and therefore will not require the system be design by a registered Oregon engineer. An engineer registered in Oregon must complete the design and details of all other systems not meeting the prescriptive requirements provided in this guide.

A project will qualify as a prescriptive installation with an acceptable supporting roof structure if all of the following criteria are met:

Roof structure: The supporting roof framing shall be of typical residential construction with multiple parallel wood roof rafters or trusses. Minimum rafter or truss chord size is 2x4 and maximum spacing is 2 ft. on center. See attached diagram. #1A

Roof materials: Roofing material must be either standing seam metal, single layer wood shingle or shake, or not more than two layers of composition shingle. Concrete or tile roofs will require structural review.

Loading: Collectors are either directly attached to the roof framing or are mounted to continuous rails that are attached directly to the roof framing. These attachments must be anchored to roof framing at a spacing no greater than 4 ft. on center maximum or per manufacturer's instructions. Collector and mounting hardware (rails, frame, etc) weight shall not exceed 4.5 pounds per square foot (psf). Solar thermal collector weight shall include the weight of the working fluid inside the collector. See attached diagram #1A.

Height: Maximum panel height above roof shall be 18" from top of panel to roof surface. See attached diagram #1B.

For additional information regarding the structural requirements for solar panel installations, please contact the AHJ local building department at (insert your jurisdiction here).

Permit Submittal Requirements

The following information shall be submitted for each permit application for a PV installation.

1. Structural Plans

a. Prescriptive system. If the system meets all of the prescriptive requirements of the structural section of this program guide, no structural plans and calculations will be required. Data showing that the solar installation meets the prescriptive requirements must be included with the site plan.

b. Designed elements.

If any of the prescriptive requirements for roof structure, roof materials, loading or height are not met, then structural calculations by an Oregon engineer showing complete details for the rails, support struts and roof attachments must be provided. In addition, stamped calculations verifying adequacy of the roof construction are required.

In the case where the support struts raise the panel height greater than 18" above the roof but all other prescriptive requirements of this program guide are met, then structural calculations by an Oregon engineer and details only for the support struts and its connections are required. In some cases, manufacturer's information and installation details may be substituted for the required engineering.

2. Elevation Drawings

For installations where the panels will not be mounted flush with the roof, a simple building elevation will be required to measure the height of the installation. The elevation must show the height of the building, and the height of the solar installation, but does not need to show other building details, unless a Design Review will be required.

t as AHJ or Building Dept.

RWR: See section 107.2 above where there are exemptions from plan review

Reference material

S13-09/10

1505.8 (New)

Proponent: Mark S. Graham, representing National Roofing Contractors Association (NRCA)

THIS PROPOSAL IS ON THE AGENDA OF THE IBC FIRE SAFETY CODE DEVELOPMENT COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

Add new text as follows:

1505.8 Photovoltaic systems. Rooftop installed photovoltaic systems that are adhered or attached to the roof covering shall be labeled to identify their fire classification in accordance with the testing required in Section 1505.1.

Reason: This proposed code change proposal is intended clarify that rooftop photovoltaic systems that are adhered or attached to the roof covering—often referred to as “building integrated photovoltaic (BIPV)”--need to comply with building code requirements for fire classification. The minimum requirement set forth here is intended for the rooftop photovoltaic system to be required to comply with the same minimum fire classification requirements as the underlying roof assembly.

Specific requirements applicable to the electrical portion of rooftop-mounted photovoltaic systems are left to the applicable electrical code.

S22-09/10

1502.1, 1507.17 (New), 1509.6 (New), Chapter 35; IRC R202, R905.16 (New), Chapter 44

Proponent: Bob Eugene, representing Underwriters Laboratories Inc

THIS IS A 3 PART CODE CHANGE. PARTS I & II WILL BE HEARD BY THE IBC STRUCTURAL COMMITTEE. PART III WILL BE HEARD BY THE IRC BUILDING/ENERGY COMMITTEE. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.

PART I – IBC STRUCTURAL

1. Add definition as follows:

1502.1 General. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

PHOTOVOLTAIC MODULES/SHINGLES. A roof covering composed of flat-plate photovoltaic modules fabricated in sheets that resemble three-tab composite shingles.

2. Add new text as follows:

1507.17 Photovoltaic modules/shingles. The installation of photovoltaic modules/shingles shall comply with the provisions of this section.

1507.17.1 Material standards. Photovoltaic modules/shingles shall be listed and labeled in accordance with UL1703.

1507.17.2 Attachment. Photovoltaic modules/shingles shall be attached in accordance with the manufacturer's installation instructions.

1507.17.3 Wind resistance. Photovoltaic modules/shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Photovoltaic modules/shingles shall comply with the classification requirements of Table 1507.2.7.1(2) for the appropriate maximum basic wind speed. Photovoltaic modules/shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table 1507.2.7.1(2).

PART III – IRC BUILDING/ENERGY

1. Add definition as follows:

SECTION R202
DEFINITIONS

PHOTOVOLTAIC MODULES/SHINGLES. A roof covering composed of flat-plate photovoltaic modules fabricated in sheets that resemble three-tab composite shingles.

2. Add new text as follows:

R905.16 Photovoltaic modules/shingles. The installation of photovoltaic modules/shingles shall comply with the provisions of this section.

R905.16.1 Material standards. Photovoltaic modules/shingles shall be listed and labeled in accordance with UL 1703.

R905.16.2 Attachment. Photovoltaic modules/shingles shall be attached in accordance with the manufacturer's installation instructions.

R905.16.3 Wind resistance. Photovoltaic modules/shingles shall be tested in accordance with procedures adapted from ASTM D 3161. Photovoltaic modules/shingles shall comply with the classification requirements of Table R905.2.4.1(2) for the appropriate maximum basic wind speed. Photovoltaic modules/shingle packaging shall bear a label to indicate compliance with the procedures adapted from ASTM D 3161 and the required classification from Table R905.2.4.1(2).

3. Add standard to Chapter 35 as follows:

UL

1703-02

Flat-Plate Photovoltaic Modules and Panels – with revisions through April 2008

PART II – IBC STRUCTURAL

Add new text as follows:

1509.6 Photovoltaic panels and modules. Photovoltaic panels and modules mounted on top of a roof shall be listed and labeled in accordance with UL 1703 and shall be installed in accordance with the manufacturer's installation instructions.

3. Add standard to Chapter 44 as follows:

UL

1703-02 Flat-Plate Photovoltaic Modules and Panels – with revisions through April 2008

Reason: (Parts I & III) The proposal provides guidance for installers and code officials regarding the installation of photovoltaic modules/shingles. These shingles are integrated with the building, and provide both a roof covering and source of electrical power. UL 1703 is the standard used to investigate and list photovoltaic modules. The appropriate design slope and fastening of the shingles are different for each manufacturer's product. For wind resistance, the procedures used in ASTM D 3161 for asphalt shingles are appropriate to use, when adapted for these types of shingles. Several companies currently have listings for these products.

(Part II) The ever increasing number of installations of photovoltaic panels and modules raises concerns about the safety of these installations. This proposal requires these products to be listed and installed in accordance with the manufacturer's instructions. UL 1703 is the standard used to investigate photovoltaic modules and panels, and includes construction and performance requirements to address potential safety hazards. Over 60 companies currently have UL 1703 listings for photovoltaic modules and panels.

Cost Impact: The code change proposal will not increase the cost of construction.

Analysis: A review of the standard(s) proposed for inclusion in the code, UL 1703-02, for compliance with ICC criteria for referenced standards given in Section 3.6 of Council Policy #CP 28 will be posted on the ICC website on or before September 24, 2009.

S28–09/10

1509.6 (New)

Proponent: Mark S. Graham, National Roofing Contractors Association (NRCA)

THIS PROPOSAL IS ON THE AGENDA OF THE IBC GENERAL CODE DEVELOPMENT COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

Add new text as follows:

1509.6 Photovoltaic systems. Rooftop mounted photovoltaic systems shall be designed in accordance with this section.

1509.6.1 Wind resistance. Rooftop mounted photovoltaic systems shall be designed for wind loads in accordance with Chapter 16.

1509.6.2 Fire classification. Rooftop mounted photovoltaic systems shall have the same fire classification as the roof assembly as defined Section 1505.

1509.6.3 Installation. Rooftop mounted photovoltaic systems shall be installed in accordance with the manufacturer's installation instructions.

Reason: Rooftop-mounted photovoltaic systems are becoming more common. This proposed code change proposal is intended clarify that rooftop-mounted photovoltaic systems need to comply with building code requirements. The minimum requirements set forth here are intended for the rooftop-mounted photovoltaic system to be required to comply with the same minimum requirements of the underlying roof assembly.

Specific requirements applicable to the electrical portion of rooftop-mounted photovoltaic systems are left to the applicable electrical code.

Cost Impact: The code change proposal will not increase the cost of construction.